USPY-2

UNIVERSITY OF FLORIDA
JAN 2 0 1998
FORESTRY LIBRARY

SO-ITF-SM-73
April 1994

Juglans jamaicensis C. DC. Nogal

Juglandaceae Walnut family

John K. Francis and Salvador Alemañy

Juglans jamaicensis C. DC., known as nogal (Spanish) and West Indian walnut (English), is a rare tree of the moist mountain forests of Cuba, Hispaniola, and Puerto Rico. This medium-sized tree (fig. 1) produces small, green flowers, an edible nut, and a beautiful wood similar to that of the black walnut tree (*J. nigra* L.) of North America.

HABITAT

Native Range

Nogal is native to the highland areas (fig. 2) of Cuba, Hispaniola, and Puerto Rico (*9*). Because of deforestation incidental to the settlement of these regions, the species has disappeared from most of its initial habitat. In 1928, nogal was reported in three forests in Puerto Rico (*2*), but by 1974 the species was feared extinct in Puerto Rico (*9*). A relict stand was discovered that contained just 14 trees (authors, personal observation). The species is also rare in both Cuba and Hispaniola where it is restricted to a few sites (*3*). Propagation programs are now under way in Puerto Rico and Cuba. The Latin name suggests that nogal is native to Jamaica, but it has been reported there only once, perhaps erroneously (*1, 12*). If that single sighting was reported accurately, then nogal is now extinct on that island (*10*).

Climate

Nogal's range in Cuba receives from 1500 to 2000 mm of annual rainfall and has a mean annual temperature of from 22 to 24 °C with possibly cooler temperatures at some of the higher elevation sites (*3*). The nogal site in Puerto Rico has annual precipitation measuring about 2000 mm and a mean annual temperature of about 22 °C (*5*). The Hispaniolan sites visited by the authors are higher in elevation and therefore probably cooler than the sites in both Cuba and Puerto Rico.

Soils and Topography

Nogal is reported to favor well-drained clay soils but will grow on soils with a variety of textures as well as soils that have pH values ranging from acid to mildly alkaline (*3*). In Cuba and Hispaniola, nogal is found most often on the banks and floodplains of rivers and streams (*7*) (authors, personal observation). The one site in Puerto Rico still supporting nogal is located midslope at an elevation of about 975 m. Nogal grows from 200 to 300 m up to an elevation of over 900 m in Cuba (*3*). Nogal may be found as high as 1,100 m in Hispaniola (authors, personal observation).

Associated Forest Cover

The former primary forest associates of nogal are unknown. Secondary forest species observed growing in association with nogal in an area near Jarabacoa, Dominican Republic, on the island of Hispaniola included: *Alchornea latifolia* Sw., *Cecropia schreberiana* Miq., *Cedrela odorata* L., *Citrus aurantium* L., *C. sinensis* Osbeck, *Coffea arabica* L., *Dendropanax arboreus* (L.) Decne. & Planch., *Guarea guidonia* (L.) Sleumer, *Inga laurina* (Sw.) Willd., *I. vera* Willd., *Pinus occidentalis* Sw., *Solanum rugosum* Dunal, and *Syzygium jambos* (L.) Alston. The one remaining stand in Puerto Rico was formerly a coffee plantation with at least some native tree species retained for shade. Important current associates include *Cecropia schreberiana*, *Cedrela odorata*, *Cordia alliodora* (Ruiz & Pav.) Oken, *Dendropanax arboreus*, *I. vera*, *Ocotea* sp., and *Schefflera morototoni* (Aubl.) Maguire & Al. (authors, personal observation).

Figure 1.—*A nogal* (Juglans jamaicensis *C. DC.) growing in Puerto Rico.*

John K. Francis is a research forester and Salvador Alemañy is a botanist at the International Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Río Piedras, PR 00928-2500; in cooperation with the University of Puerto Rico, Río Piedras, PR 00936-4984.

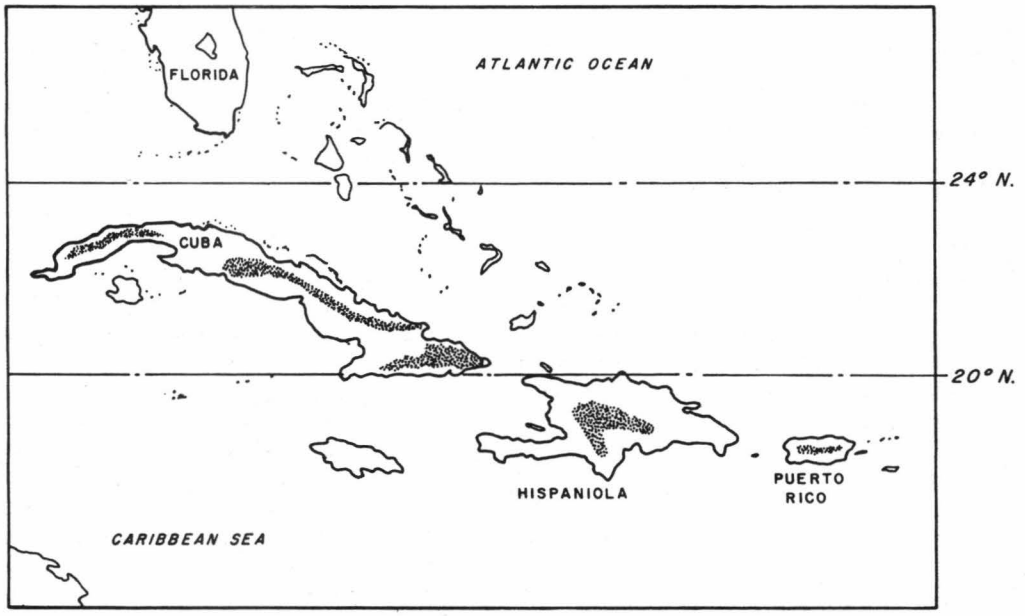

Figure 2.—*The historical native range of nogal* (Juglans jamaicensis *C. DC.) in the Greater Antilles indicated by the shaded area.*

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—Nogal flowers are small (about 6 mm long) and green. Male and female flower clusters (catkins) are borne on the same tree (monoecious) (*9*). The clusters of male flowers, borne on the previous year's twigs, are 10 to 13 cm long. The 3- to 5-cm female flower clusters grow at the base of new twigs (*9*). The species is reported to flower in February and March (*3*) or April (*7*). Flowers and small, green fruits were observed on one tree in the Dominican Republic in March (authors, personal observation). In Cuba (*7*), the fruits ripen in June, about 3 months after flowering. The nuts ripen and fall during the early summer in Puerto Rico and can be collected throughout the summer months.

Seed Production and Dissemination.—Nogal trees appear to produce from several to 100 or more moderately large seeds during a seed year (authors, personal observation). Three samples taken from Cuba averaged 130 seeds per kilogram (*11*), 181 seeds per kilogram,[1] and 150 seeds per kilogram (*7*). A sample from Hispaniola averaged 111 seeds per kilogram (authors, personal observation). Seeds collected in Puerto Rico averaged 115 seeds per kilogram (authors, personal observation).

Seeds may be collected by gathering them from the ground below fruiting trees 2 or 3 months after fruit fall, which allows sufficient time for the rind to rot. Mature or freshly fallen fruit can be collected and either macerated to remove the rind or composted to promote its natural removal by rotting. Nogal seeds are disseminated principally by humans, although gravity and water also contribute to the process. No animal disseminators are known.

Seedling Development.—Germination in nogal is hypogeous (*7*). Fresh seeds probably require afterripening for 3 months or more before germinating. One sample of seeds that had been on the forest floor an unknown length of time began germinating 41 days after sowing (authors, personal observation); 40-percent germination was obtained. Fifty-one percent of a Cuban sample germinated within 90 days of sowing (*7*).

After germination, seedling development is rapid. Sixty seedlings raised under shade by the authors reached a 25-cm height in 6 to 7 weeks. Seedlings in Cuba reached heights of 40 cm in 3 months, 80 cm in 6 months, 1 m in 1 year, and 1.5 m in 2 years (*7*). One fertilized seedling in an area in Puerto Rico receiving 1900 mm of annual rainfall added 2 m of height in its first year in the field. An unfertilized planting of nine trees in an area of similar rainfall grew 0.6 m in 14 months with no mortality (authors, personal observation). At least two planting failures have occurred in Puerto Rico apparently because the seedlings were planted on sites with too much rainfall (2500 to 3000 mm mean annual precipitation) (authors, personal observation).

Seedlings of nogal are common below seed-bearing trees in Cuba (*3*). Seedlings are also common in Hispaniola, but because of brush cleaning in the bottomland pastures and coffee plantations where nogal grows, small saplings rarely progress to pole- and sawlog-sized trees. Seedlings or saplings were not observed, and just one pole-sized tree was present in the Puerto Rican stand (authors, personal observation).

Vegetative Reproduction.—Young nogal trees sprout abundantly (*3*). They have not been tested for grafting and rooting of cuttings. However, nogal can probably be grafted in the same manner as *J. nigra* (*13*).

[1]Wadsworth, Frank H. 1945. Memo 738 dated 08/07/45. On file with: International Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Río Piedras, PR 00928-2500.

Sapling and Pole Stage to Maturity

Growth and Yield.—Nogal is a medium-sized tree that occasionally reaches a large size. Trees in Cuba have attained 30 m in height and 60 cm in diameter at breast height (d.b.h.) (*3*). Thirteen nogal trees located by the authors near Jarabacoa, Dominican Republic, had d.b.h.'s that ranged from 10 to 64 cm with an average of 43 cm. Heights averaged 17 m, with a range of 6 to 36 m. The 14 known nogal trees in Puerto Rico ranged from 8 to 83 cm in d.b.h. with an average of 32 cm. Height measured from 7 to 22 m with an average of 15 m (authors, personal observation). Ages of all the previously described trees are unknown.

Rooting Habit.—Seedlings develop a relatively shallow taproot and many fibrous lateral roots. An examination of nogal roots in Cuba showed infection with ectomycorrhizal fungi in contrast to *J. nigra,* which is reported to have endomycorrhizal fungi (*6*) . Old trees observed by the authors have robust lateral roots partially exposed near the trunk when growing on clayey soil. Buttresses are small.

Reaction to Competition.—Nogal is intolerant of shade. Seedlings survive for only about 1 year in shady understory without release. Adult trees do well in dominant or codominant crown positions and survive for many years in intermediate crown positions. However, they do not appear able to survive for extended periods in suppressed positions. Moderately wide spacings of 3 by 3 m to 4 by 4 m and complete weed control around seedlings until they reach approximately 2 m in height is recommended. Betancourt (*3*) recommends enrichment planting in artificial openings 7 to 8 m across or in cleared lines one-third to one-half the height of the existing forest.

Damaging Agents.—No serious threats to the species have been observed. However, the leaves of nogal are subject to attack by leafhoppers, leafrollers, and serpentine leafminers. Saplings in a small planting in central Puerto Rico suffered partial defoliation by a weevil (Curculionidae) (authors, personal observation). A few of the nuts collected by the authors in the Dominican Republic had holes bored through their shells by an unidentified insect. Also, a leaf anthracnose killed several seedlings and partially defoliated others in a shade house in Puerto Rico (authors, personal observation). This problem occurred only during periods of excess humidity within the shade house. It was not observed when the seedlings were exposed to full sunlight.

SPECIAL USES

The wood of nogal is nearly identical to that of *J. nigra,* one of the finest and most expensive furniture and craft woods in the world. Two trees bored by the authors in Puerto Rico had dark, gray-brown heartwood with densities of 0.60 and 0.69 g/cm^3. Wood densities between 0.4 and 0.8 g/cm^3 (depending on age) are reported for nogal trees in Cuba (*7*). The heartwood of Cuban trees is described as chestnut or brown with purplish streaks; the sapwood is nearly white. Because of its rarity, nogal lumber has not been sawed in recent years. However, future plantations may provide an exceptional wood to craftsmen and manufacturers of fine furniture.

Nogal produces a nut similar in quality to that of *J. nigra.* The popularity of nogal is limited by its rarity. Few people in Puerto Rico and the Dominican Republic have even heard of the tree, and fewer still have tasted its nut. Seedlings of the species beyond those needed for habitat restoration and forestry trials should be offered for rural plantings in areas of favorable climate.

GENETICS

Nogal belongs to the botanic section of walnuts, Rhysocaryon, typified by *Juglans nigra* L. Synonyms for *J. jamaicensis* are *J. cinerea* Bello, *J. domingensis* Dode, *J. fraxinifolia* Descourtilz, *J. insularis* Griseb., and *J. portoricensis* Dode (*10*). Herbarium specimens from Cuban and Hispaniolan provenances are similar; the nuts in samples from Puerto Rico were somewhat distinct in color and ridge pattern from those of the other two provenances (*10*). A difference was noted in seedling leaves produced by Puerto Rican and Hispaniolan sources (fig. 3). In the Puerto Rican source, the first compound leaves of seedlings displayed the general adult form, whereas in the Hispaniolan source, an intermediate form with a large terminal leaflet persisted in the first two or three compound leaves (authors, personal observation). *Juglans* spp. have been present in Puerto Rico for a very long time. Fossil material ascribed to *J. archaeoantillana,* including well-defined nuts, were found among lignitic debris (probably post-Pliocene) in a river valley in northern Puerto Rico (*4, 8*). Nogal is most closely related to *J. venezuelensis* Manning of northern South America (*10*).

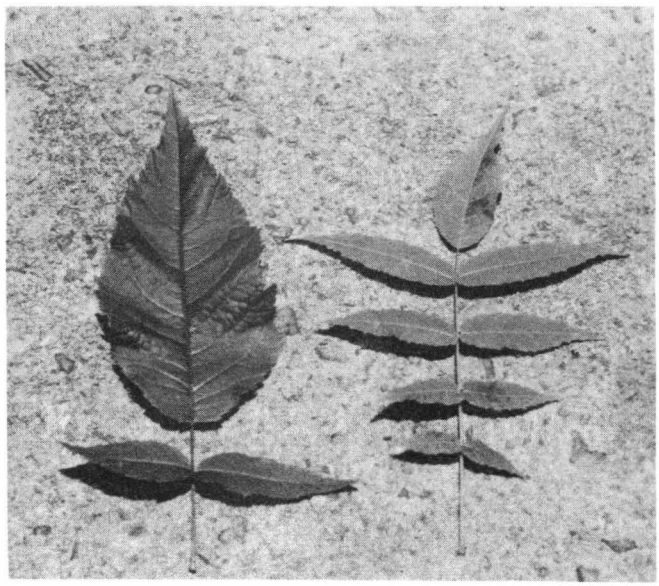

Figure 3.—*Comparison of the second compound leaves formed in seedlings of nogal* (Juglans jamaicensis *C. DC.) of a Hispaniolan source (left) and a Puerto Rican source (right).*

UNIVERSITY OF MINNESOTA
3 1951 D02 980 897 Z

LITERATURE CITED

1. Adams, C.D. 1972. Flowering plants of Jamaica. Mona, Jamaica: University of the West Indies. 848 p.
2. Bates, Charles Z. 1929. Efectos del huracán del 13 de septiembre de 1928 en distintos árboles. Revista de Agricultura de Puerto Rico. September: 113–117.
3. Betancourt Barroso, A. 1987. Silvicultura especial de árboles maderables tropicales. Havana, Cuba: Editorial Científico-Técnica. 427 p.
4. Britton, N.L. 1926. Further botanical investigation in Puerto Rico. New York Botanical Garden Journal. 27(317): 97–102.
5. Calvesbert, Robert J. 1970. Climate of Puerto Rico and U.S. Virgin Islands. Climatogr. U.S. No. 60-52. Silver Springs, MD: U.S. Department of Commerce, Environmental Science Service Administration, Environmental Data Service. 29 p.
6. Ferrer, Robert L.; Herrera, Ricardo A. 1988. Micotrofía en Serra del Rosario. In: Herrera, Ricardo A.; Menendez, Leda; Rodríguez, Marla A.; García, Elisa E., eds.: Ecología de los bosques siempreverdes de la Sierra del Rosario, Cuba. Proyecto MAB No. 1, 1974–1987. Havana, Cuba: Academia de Ciencias de Cuba, Instituto de Ecología y Sistematica. 473–484.
7. Fors y Rayes, Alberto. 1947. Manual de silvicultura. Havana, Cuba: Ministerio de Agricultura. 323 p.
8. Hollick, Arthur. 1928. Paleobotany of Puerto Rico. New York Academy of Sciences Scientific Survey of Puerto Rico. 7(3): 177–180.
9. Little, Elbert L., Jr.; Woodbury, Roy O.; Wadsworth, Frank H. 1974. Trees of Puerto Rico and the Virgin Islands. Second volume. Agric. Handb. 449. Washington, DC: U.S. Department of Agriculture. 1,024 p.
10. Manning, Wayne E. 1960. The genus *Juglans* in South America and the West Indies. Brittonia. 12(1): 1–26.
11. Marrero, José. 1949. Tree seed data from Puerto Rico. Caribbean Forester. 10: 11–30.
12. Urban Igantius. [n.d.]. Symbolae Antillanae. Leipzig, Germany: Fratres Borntraeger. 771 p. Vol. 4.
13. Williams, Robert D. 1990. *Juglans nigra* L. Black walnut. In: Burns, Russel M.; Honkala, Barbara H., eds. Silvics of North America. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture: 391-399. Vol. 2.

*U.S.GPO:1994-565-016/00004